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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/724,787	12/01/2003	Gianluca Paladini	2002P19673 US01	1913

7590 12/26/2008

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EXAMINER	
RICHER, AARON M	

ART UNIT	PAPER NUMBER
2628	

MAIL DATE	DELIVERY MODE
12/26/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/724,787	PALADINI, GIANLUCA	
	Examiner	Art Unit	
	AARON M. RICHER	2628	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 October 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) *10* is/are allowed.

6)☒ Claim(s) *1-7,9,11-20 and 22-27* is/are rejected.

7)☒ Claim(s) *8 and 21* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed October 15, 2008 have been fully considered but they are not persuasive.

2. Applicant argues that Halmann does not use values of the tables in Halmann to identify ultrasound data. Examiner disagrees with this assertion, noting that Halmann does disclose scan conversion tables (col. 7, lines 54-57) and then performing scan conversion via interpolation (col. 8, line 53-col. 9, line 4), as noted in the previous action's Response to Arguments. The conversion of the data reads on an identification of the data. Applicant further argues that an inverse lookup does not occur, if the input to the table is Polar coordinates and the output is Cartesian, because the process flows by providing Polar data. Examiner notes that regardless of which way the process flows, the processor still identifies the ultrasound data as a *function* of the values and uses the data to interpolate. As in the previous Office Action's example, if one uses a lookup table, such as below, to perform a function:

A	B
1	2
2	4
3	6
4	8

then it is irrelevant what order the process takes. If A is known, and B is looked up, or if B is known, and A is looked up, in both cases, the table values are being used to identify the original data and lookup/interpolate the final data.

3. Applicant's arguments with respect to the new limitations of claims 1, 11, 14, and 15 have been considered but are moot in view of the new ground(s) of rejection.

4. As to claims 3 and 16, applicant argues that the area of interest is not used to identify acquired data. Examiner notes that Halmann does locate an area of interest, as admitted by applicant. Examiner further notes that as stated in examiner's arguments regarding claim 1, ultrasound data is identified and converted by the lookup table.

5. As to claims 5 and 18, applicant argues that rendering can account for any coordinate system, meaning that examiner's assertion that there is no way to render an image if the original coordinates are polar is untrue. Examiner notes that, assuming the display is a typical display divided into lines and columns, some sort of scan conversion into Cartesian coordinates must take place, since to drive the display correctly, one will have to obtain the row and column numbers of the pixels. Examiner notes that Halmann discloses lookup tables as the method for scan conversion and one skilled in the art would therefore reasonably conclude the tables would be used with the raycasting module.

6. As to claim 26, applicant argues that generating a two-dimensional lookup table with acquisition coordinates for every coordinate of a Cartesian volume is not necessary in the invention of Halmann. However, examiner points out that the LUT is Halmann's

method of performing scan conversion, and as pointed out above, some sort of conversion must be done to obtain display data.

7. As to claim 2, applicant argues that Halmann does not disclose coordinate values in the lookup table, and further does not disclose Polar coordinates indexed by Cartesian coordinates. However, col. 7, lines 50-58 of Halmann explicitly state that the tables convert between Polar and Cartesian coordinates.

8. As to claim 4, applicant argues that Hossack does not use plane coordinates as an input to the lookup table and that Halmann treats volume rendering separately from scan conversion. However, examiner points out that the LUT is Halmann's method of performing scan conversion, and as pointed out above, some sort of conversion must be done to obtain display data.

9. As to claims 6 and 19, applicant argues that Okerlund is not compatible with Halmann because Halmann uses CPU rendering, while Okerlund uses hardware rendering. Examiner notes that the methods are not so different as to be incompatible. Techniques that are not hardware-specific can be used with both a CPU and a GPU, and so it appears that the two references are compatible.

10. As to claim 12, applicant argues that a person skilled in the art would not have picked a flag and integer sum as mere design choices. However, examiner notes that both of these two are common variable types in computer programming, and a programmer skilled in the art would certainly at least consider those options. Examiner agrees that the programmer may not pick those specific classes, but that simply

supports examiner's position that the types of variables are a design choice and there is no criticality to picking one over the other.

Claim Rejections - 35 USC § 101

11. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

12. Claims 14-20 and 22-27 rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

13. The claims are rejected under 35 U.S.C. 101 as not falling within one of the four statutory categories of invention. While the claims recite a series of steps or acts to be performed, a statutory "process" under 35 U.S.C. 101 must (1) be tied to another statutory category (such as a particular apparatus), or (2) transform underlying subject matter (such as an article or material) to a different state or thing (Reference the May 15, 2008 memorandum issued by Deputy Commissioner for Patent Examining Policy, John J. Love, titled "Clarification of 'Processes' under 35 U.S.C. 101"). The instant claims neither transform underlying subject matter nor positively tie to another statutory category that accomplishes the claimed method steps, and therefore do not qualify as a statutory process.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

> invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

15. Claims 1, 3, 5, 11-14, 16, 18, and 24-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Halmann (U.S. Patent 6,526,163) in view of Seiler (EP 1,093,085).

16. As to claim 1, Halmann discloses a system for scan converting ultrasound data from an acquisition format to a display format, the system comprising:

a look-up table having values corresponding to a spatial conversion from the display format to the acquisition format (col. 7, lines 54-57; a number of scan conversion tables are generated);

and a processor operable to identify acquired ultrasound data as a function of the values and operable to interpolate display values from the identified acquired ultrasound data (col. 8, line 52-col. 9, line 4).

Halmann does not disclose that the processor is operable to avoid scan conversion of volume data that does not contribute to a final volume rendered image, the identifying corresponding to identifying for display format coordinates associated with visible voxels of the final volume rendered image. Seiler, however, discloses voxel visibility tests performed for each voxel, so that only the visible voxels are rendered (see abstract, fig. 9, and col. 13-14, sections 0076-0082; also see col. 10-13 for the specifics of how visibility tests are performed), meaning that only the viewable voxels get actual display coordinates (scan conversion). The motivation for this is to reduce time needed to render a volume (col. 12, section 0066). It would have been obvious to one skilled in

the art to modify Halmann to only scan convert visible voxels in order to save time as taught by Seiler.

17. As to claim 3, Halmann discloses a system wherein the processor is operable to determine display coordinates of interest (col. 8, lines 4-9; an area of interest is defined and polar coordinates are defined from this area) and identify the acquired ultrasound data by inputting the display coordinates of interest into the look-up table (col. 7, lines col. 7, lines 54-57; col. 8, line 52-col. 9, line 4; the process of scan conversion finds ultrasound data coordinates for display coordinates by converting from polar to Cartesian).

18. As to claim 5, Halmann discloses a system wherein the acquired ultrasound data represents a volume in the acquisition format, wherein the processor is operable to determine display coordinates for a plurality of rays through the volume as the display coordinates of interest (col. 5, lines 35-40; a volume rendering/raycasting module produces an image for display, which must include determination of display coordinates);

further comprising a display operable to display a two-dimensional image of a Volume Rendering of at least a portion of the volume in the display format with the display values (fig. 1, element 16; col. 5, lines 35-40).

19. As to claim 11, Halmann discloses a system wherein the processor comprises a central processing unit (col. 8, line 52-col. 9, line 4; Halmann discloses a number of CPUs set up for scan conversion). Official notice has been taken of the fact that performing graphics operations in a GPU is well-known in the art (see MPEP 2144.03).

It would have been obvious to one skilled in the art to modify Halmann to perform scan conversion in a separate GPU in order to more quickly process data.

20. As to claim 12, Halmann does not disclose a system wherein the look-up table values each comprise a set of two fixed-point values, one Boolean Flag, and one Integer Sum, the two fixed-point values being Polar coordinates. These, however, are all arbitrary classes of variables and there is no disclosed criticality to them in applicant's specification. The choosing of these particular classes of variables appears to be a matter of design choice. One skilled in the art would expect the inventions of Halmann and Seiler to work equally well with various other types of variables, such as integers, floating point variables, etc.

21. As to claim 13, Halmann does not expressly disclose a system wherein a Boolean Flag indicates whether the set corresponds to a location outside of a scanned region. However, Official Notice has been taken of the fact that setting a variable for when data is in or out of a range is well-known in the art (see MPEP 2144.03). It would have been obvious to one skilled in the art to modify Halmann and Seiler to set a variable when data is out of range in order to communicate this error to other parts of a computing system.

22. As to claim 14, Halmann discloses a method for scan conversion of ultrasound data from an acquisition format to a display format, the method comprising:

(a) identifying acquisition format coordinates with display format coordinates indexed to a look-up table (col. 8, lines 3-9; col. 7, lines 54-57; polar coordinates are acquired and changed to display, or Cartesian, coordinates via a lookup table);

(b) interpolating acquisition format coordinates stored in the look-up table (col. 7, lines 54-57; col. 8, line 52-col. 9, line 4);

and (c) interpolating display values from acquired ultrasound data based on the acquisition format coordinates determined in (b) (col. 7, lines 54-57; col. 8, line 52-col. 9, line 4; interpolation takes place to map the acquisition, or polar coordinates, to display, or Cartesian coordinates).

23. As to claim 16, see the rejection to claim 3.

24. As to claim 18, see the rejection to claim 5.

25. As to claim 24, Halmann discloses generating the look-up table as a function of a spatial relationship of a display format with user configured acquisition parameters (col. 7, lines 54-59; tables generated are dependent on a selected mode of operation; col. 3, lines 59-62 states that this mode is determined by a user and col. 5, line 51-58 states that the mode determines acquisition parameters).

26. As to claim 25, see the rejection to claim 13.

27. As to claim 26, Halmann discloses a system wherein (d) comprises generating a two-dimensional look-up table with acquisition format coordinates for each coordinate of a Cartesian volume (col. 7, lines 54-57; col. 8, line 52-col. 9, line 4; a lookup table for Cartesian coordinates would have to use at least x and y coordinates, inherently making it a 2-dimensional lookup table).

28. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Halmann in view of Seiler and Zar ("A Scan Conversion Engine for Standard B-Mode Ultrasonic Imaging").

29. As to claim 2, Halmann discloses values comprising polar coordinates and lookup table entries indexed by Cartesian coordinates (col. 7, lines 54-57; col. 7, lines 54-57), but does not expressly disclose a processor operable to bilinearly interpolate from the look-up table values using fractional offsets of Cartesian coordinates. Zar, however, discloses a bilinear interpolation using fraction offsets of Cartesian coordinates (p. 1, Introduction) to be able to convert to polar using a lookup table (p. 2, LUTs and Constant LUTs sections). The motivation for using this system is to accomplish scan conversion at a very low cost (p. 1, Abstract). It would have been obvious to one skilled in the art to use bilinear interpolation and LUTs to convert polar to Cartesian coordinates in order to reduce cost as taught by Zar.

30. Claims 4 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Halmann in view of Seiler and Hossack (U.S. Patent 6,352,511).

31. As to claim 4, Halmann discloses a system wherein the acquired ultrasound data represents a volume in the acquisition format (col. 5, lines 35-40) and also a system comprising a display operable to display a two-dimensional image representing the plane in the display format with the display values (fig. 1, element 16). Halmann does not disclose a system wherein the processor is operable to determine display coordinates for a plane through the volume as the display coordinates of interest. Hossack, however, discloses a system that allows for display of an arbitrary 2-dimensional plane through a 3-dimensional volume (col. 17, lines 4-11). The motivation for this is to allow the ultrasound image to better act as a diagnostic aid (col. 16, lines 50-57). It would have been obvious to one skilled in the art to modify Halmann and

Seiler to determine display coordinates for a plane through a volume in order to better diagnose a patient as taught by Hossack.

32. As to claim 17, see the rejection to claim 14. Hossack further discloses displaying a two-dimensional MPR image representing the plane in the display format as a function of the display values (col. 17, lines 4-11).

33. Claims 6 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Halmann in view of Seiler and Okerlund (U.S. Patent 6,690,371)

34. As to claim 6, Halmann does not disclose a system wherein each of the display values is a function of an alpha blending of a plurality of acquired ultrasound data values and wherein the processor is operable to limit a number of acquired ultrasound data values blended as a function of a threshold such that scan conversion of other acquired ultrasound data values is avoided. Okerlund, however, discloses alpha blending ultrasound data values (col. 7, lines 4-19; RGBA values are used to blend), and limiting the number of values blended to a "decimated" volume (fig, 13; col. 11, lines 8-35) with a threshold of less than a full volume. The motivation for this is to more rapidly render an image volume (col. 11, lines 8-10). It would have been obvious to one skilled in the art to modify Halmann and Seiler to use a threshold to ensure only some ultrasound data is blended in order to reduce time taken to display as taught by Okerlund.

35. As to claim 19, see the rejection to claim 6.

36. Claims 7 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Halmann in view of Seiler and Drebin (U.S. Patent 4,835,712).

37. As to claim 7, Halmann does not disclose a system comprising an RGBA look-up table addressed by the display values, the RGBA look-up table operable to output an RGBA value corresponding to the display value. Drebin, however, discloses a system that inputs monochrome display values to a lookup table and outputs RGBA values for those values (col. 7, lines 44-62). The motivation for this is to simulate an image illuminated by one or more sources of light (col. 2, lines 4-24). It would have been obvious to one skilled in the art to modify Halmann and Seiler to use a lookup table to convert between display values and RGBA values in order to simulate an image illuminated by one or more sources of light as taught by Drebin.

38. As to claim 20, see the rejection to claim 7.

39. Claims 9 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Halmann in view of Seiler and Swerdloff (U.S. Patent 5,483,567).

40. As to claim 9, Halmann does not disclose a system wherein the look-up table values correspond to the spatial conversion from the display format to the acquisition format for at least one acquisition plane; further comprising an additional look-up table corresponding to spatial conversion from the display format to the acquisition format across multiple acquisition planes. Swerdloff, however, discloses a system wherein a change in relationship between polar and Cartesian voxels, such as a change when changing an acquisition plane, necessitates creation of another lookup table (col. 9, lines 6-25). This is motivated by the fact that the current lookup table will no longer be accurate (col. 9, lines 19-25). It would have been obvious to one skilled in the art to

modify Halmann and Seiler to use an additional lookup table when multiple acquisition planes are used in order to have an accurate lookup table as taught by Swerdloff.

41. As to claim 22, see the rejection to claim 9.

42. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Halmann in view of Seiler and Fattah (U.S. Patent 7,274,325)

43. As to claim 15, Halmann discloses a method wherein (a) comprises: (a1) inputting coordinates into the look-up table; and (a2) outputting coordinates interpolated from the look-up table in response to (a1) (col. 7, lines 54-57; col. 8, line 52-col. 9, line 4; the process of scan conversion involves a polar to Cartesian conversion via lookup table and interpolation). It is noted that Halmann does not explicitly teach inputting Cartesian coordinates and outputting Polar coordinates, instead performing data conversion the other way. However, it is also noted that the Cartesian-Polar lookup table is known in the art as shown by Fattah (fig. 7b; col. 11, lines 2-41). The motivation for using this method is to allow greater efficiency and enable a software based system to work in real time. It would have been obvious to one skilled in the art to modify Halmann and Seiler to lookup Cartesian coordinates and output Polar coordinates in order to allow greater efficiency as taught by Fattah.

44. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Halmann in view of Seiler and Edic (U.S. Publication 2004/0136490).

45. As to claim 27, Halmann does not disclose a method further comprising: (d) Volume Rendering as a function of the display values as a function of time. Edic, however, discloses a method of volume rendering in which the motion of a volume over

time is depicted (p. 4-5, section 0045). The motivation for this is to represent a cycle, such as a cardiac cycle (p. 4-5, section 0045). It would have been obvious to one skilled in the art to modify Halmann and Seiler to volume render using display values as a function of time in order to represent a cardiac cycle as taught by Edic.

Conclusion

46. Claim 10 is allowed.

47. Claims 8 and 21 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to AARON M. RICHER whose telephone number is (571)272-7790. The examiner can normally be reached on weekdays from 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kee Tung can be reached on (571) 272-7794. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Aaron M Richer/
Examiner, Art Unit 2628
12/17/08